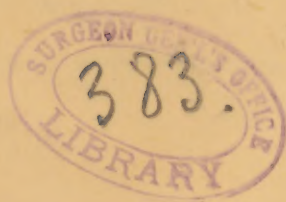


DUDLEY. (W^m L.)

A CHART FOR THE CHEMICAL
EXAMINATION OF URINE x x x x x



Prof. J. W. Clarke
Compliments of Wm. L. Dudley
A CHART

FOR THE

Chemical Examination of Urine;

ALSO,

Tables of the Metric Weights and Measures, and Rules for converting
the Apothecaries' Weights and Measures into Metric terms.

BY

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FOR THE USE OF THE STUDENTS.



CHEMICAL EXAMINATION OF URINE,

Books of Reference: Neubauer & Vogel, Harley, Tyson, Flint, and Hofmann & Uitzmann.

In the examination of urine, observe: I. Quantity passed in twenty-four hours.₁
II. Color and Transparency.₂ III. Odor. IV. Reaction.₃ V. Specific gravity.₄
VI. Presence or absence of sediments.

EXAMINATION OF THE CLEAR URINE.₅

VII. **Albumen.**₆—If the urine has a distinctly acid₇ reaction heat to boiling, and if a precipitate forms, add an excess of nitric acid (HNO_3). In case the precipitate remains undissolved, it indicates the presence of Albumen. If the urine is neutral or alkaline, add nitric acid until it has a strong acid reaction, and boil. A white precipitate or opacity, indicates the presence of Albumen.

VIII. **Sugar.** 1. (TROMMER'S TEST)—Remove the albumen,₂₁ if present, by filtering the above, and to the filtrate add an equal amount of sodium or potassium hydrate (NaOH or KOH .) and a drop or two of a dilute solution of copper sulphate (CuSO_4), heat nearly₈ to boiling without shaking, when a yellow cloud will form on the surface, and soon a yellow or red precipitate of the oxide of copper will follow without further heating, if *sugar* be present. To confirm the presence of sugar, prepare another sample in the same manner, and allow it to stand quietly for 6-24 hours, without heating.

2. (FEHLING'S TEST).—This test is based on the same reaction as the above, but is more delicate. Prepare two solutions, as follows:

No. 1.	Copper Sulphate, (pure crystals,).....	51.98 grams, (801.25 grs.)
	Water.....	500 c. c. (17 floz.)
No. 2.	Rochelle Salt, (pure crystals,).....	259.9 grams, (4011, 29 grs.)
	Solution Sodium Hydrate Sp. gr. 1.12.....	1000 c. c. (33.8 floz.)

In using, mix in a test-tube one volume of No. 1, and two volumes of No. 2; shake, add an equal volume of the urine to be tested, and boil. If sugar is present, the same changes will take place as those described in *Trommer's* test.

IX. **Normal Coloring Matters.**—1. UROHÆMATIN OR UROCHROM.—Dilute the 24 hours' urine with distilled water until it measures 1800 c. c. (60 floz.); or, if the quantity exceeds 1800 c. c. concentrate to this amount, then add to about 7 c. c., (1.9 dr.) of it in a test-tube, 2 c. c. of pure concentrated nitric acid, and allow the mixture to stand for some time. If *Urohæmatin* is in normal quantities, only a slight change of color will be seen; but if in excess, it will become pink, red, crimson, or purple, according to the amount present.

2. INDICAN OR UROXANTHIN.—To 3 or 4 c. c. of pure concentrated hydrochloric acid (HCl .) in a beaker, add while stirring, 10 to 20 drops of urine. If in normal quantity, the solution will be colored pale yellowish-red. If in larger quantities, the coloration will be violet or blue. If biliary acids are present, add lead acetate [$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$], filter, and then test for *Indican*.

NOTES.

1. The normal amount of urine passed in 24 hours is about 1200—1500 c. c., (40—50 floz.)
2. The normal color of urine is *pale yellow* or *amber hued*.
3. The reaction of normal urine is *acid*, but continued vegetable diet will cause it to become *alkaline*. The urine of herbivorous animals is normally alkaline, while that of carnivorous animals is strongly acid.
4. The specific gravity of normal urine varies from 1.005 to 1.030, according to age and sex, constitution of body, and food.
5. If the urine is not clear it should be filtered before beginning the examination.
6. A rough test for *albumen* may be made in the sick room by boiling some of the urine in a spoon. The result should always be verified by the regular method.
7. In cases where the urine is only feebly acid, a precipitate of earthy phosphates may occur where they exist in excess, which might easily be mistaken for albumen; consequently it will be necessary to add an excess of nitric acid, which will dissolve them while the albumen, if present, will remain insoluble.
8. In Trommer's test, do not boil.
9. Urine containing bile has a brown color.
10. When a water-bath cannot be had, an ordinary tin cup (pint) may be used as a substitute. Fill it about one-half full of water, rest the evaporating dish containing the urine on the top of the cup, and heat the water to boiling, continuing until the urine has evaporated sufficiently.

X. **Abnormal Coloring Matters.**—1 BLOOD.—Add sodium hydrate to the urine, and the earthy phosphates will be precipitated. If blood is present the precipitate will be blood-red instead of white.

2. **UROERYTHRIN.**—Known by the pink coloration of the sediment known as “lateritious,” or by the formation of a pink-colored precipitate, with a few drops of lead acetate. If the urine contains hæmatin, or the coloring matter of blood, it must first be removed.

3. **VEGETABLE COLORING MATTERS.**—Known by the red alkaline urine turning yellow on the addition of an acid, and acquiring a red color again on the addition of ammonium hydrate (NH_4OH).

4. **BILIARY COLORING MATTERS.**⁹—Pour into a beaker 6 c. c. of pure concentrated hydrochloric acid, and add to it, drop by drop, just sufficient urine to color it; “underlay” the mixture with pure concentrated nitric acid. A beautiful play of colors will appear if *biliary coloring matters* are present. Or, add to the suspected urine, albumen, and coagulate with nitric acid; after standing the coagulum will have a bluish color. A solution of lead acetate added to urine containing bile, produces a yellowish precipitate. Tincture of iodine produces a beautiful green, varying from rose to yellow color. No secretion, except bile, will give this green coloration. (M. Maréchal’s test).

XI. **Uric Acid.**—A small portion of the sediment, or residue, after evaporation, is placed in a porcelain dish, and a drop or two of nitric acid added to dissolve it; it is then carefully evaporated to dryness on a water-bath.¹⁰ When dry, add a drop or two of ammonium hydrate, and a beautiful purple-red color will instantly be seen.

XII. **Urea.**¹¹—Take of the fresh 24 hours urine¹² two samples; to the first add about one-third of its volume of pure concentrated nitric acid; if crystals form in this immediately, or within a few moments, the amount of urea is *above* the normal. The second sample should be twice the bulk of the first. Evaporate it to one-half its volume (on a water-bath), allow it to cool, and add nitric acid as before. If the crystals do not form within a few moments, the proportion of urea is *below* the normal.

XIII. **Chlorides.**¹³—Add silver nitrate (AgNO_3) and nitric acid. A white precipitate indicates the presence of chlorides.¹⁴

XIV. **Phosphates.**—1. **EARTHY PHOSPHATES**¹⁵—Add ammonium hydrate in excess, and boil. A precipitate indicates *earthy phosphates*.

2. **ALKALINE PHOSPHATES**¹⁶—Filter the above, and to the filtrate add a solution of magnesium sulphate (MgSO_4). A white crystalline precipitate indicates the presence of *alkaline phosphates*.

XV. **Sulphates.**¹⁷—Add to the urine a solution of barium chloride, and an excess of hydrochloric acid. A white precipitate indicates the presence of sulphates.

EXAMINATION OF THE SEDIMENT.

Decant as much of clear urine as possible, and shake up the remainder in order that the sediment may be suspended.

I. **Urates.**²²—Heat a portion of the above to boiling, and the urates will dissolve. If a residue remains, filter, and test the filtrate for uric acid according to XII, or cool the filtrate, and crystals of the *urates* will slowly form.

II. **Phosphates.**—If a residue remains undissolved in the proceeding, heat another portion of the sediment with acetic acid ($\text{C}_2\text{H}_4\text{O}_2$), and, if necessary, filter, and to the filtrate add ammonium hydrate and heat. A white precipitate will indicate the presence of *phosphates*.

III. **Pus.**—Take a fresh sample of the sediment, and add a solution of sodium or potassium hydrate. If *pus* be present, a gelatinous mass will be produced.

Further examination of the sediment for mucus, pus, urea, etc., is best made by the aid of the microscope, ¹⁸ ¹⁹ ²⁰.

11. When acid is added to the urine and effervescence takes place, it indicates the presence of ammonium carbonate, which is due to the decomposition of urea in the bladder.

12. If the quantity of urine passed in 24 hours is less than 1200 c. c. (40 floz.), it should be diluted with distilled water to that amount; and on the contrary, if it exceeds 1200 c. c., it should be evaporated to that quantity on a water-bath.

13. The presence of a moderate amount of *albumen* does not interfere with the tests for *chlorides*, but if it is abundant, it must be removed.

14. If the amount of urine passed in 24 hours is normal, the precipitate of the *chlorides*, according to XII, should be about of the consistency of milk.

15. Normal urine, which has been recently passed, should contain no sediments of *earthy phosphates*.

16. A milk-like cloudy appearance indicates about a normal amount of *alkaline phosphates*.

17. A milk-like cloudy appearance indicates about a normal amount of *sulphates*.

18. Urine containing *mucus* is generally cloudy, ropy and alkaline.

19. Urine containing *pus* always contains albumen, and the pus settles to the bottom readily.

20. Urine containing *fat*, is milky, opaque and albuminous. The fat comes to the surface on standing.

21. Albumen is very rarely present with sugar.

22. A sediment rarely contains both urates and phosphates.

METRIC SYSTEM OF WEIGHTS AND MEASURES.

MEASURES OF LENGTH.

10 Millimeters, = 1 Centimeter.
 10 Centimeters, = 1 Decimeter.
 10 Decimeters, = 1 Meter.
 10 Meters, = 1 Decameter.
 10 Decameters, = 1 Hectometer.
 10 Hectometers, = 1 Kilometer.

10 Kilometers, = 1 Myriometer.
 1 Kilometer, = 4 Furlongs, 213 yds, 1 foot and 10.43 inches.
 1 Meter, = 39.37043 inches. 1 inch, = 25 millimeters, = 0.025 meter.

MEASURES OF CAPACITY.

1 Milliliter, (1 Cubic Centimeter).
 10 Milliliters, = 1 Centiliter.
 10 Centiliters, = 1 Deciliter.
 10 Deciliters, = 1 Liter, or cubic decimeter.
 10 Liters, = 1 Decaliter, or centister.
 10 Decaliters, = 1 Hectolitre, or decister.

10 Hectoliters, = 1 Kiloliter, or stere or cubic meter.
 10 Kiloliters, = 1 Myrioliter, or decaster.
 1 Liter, = 61.027052 cubic inches, = 2.1 pints, (nearly).
 1 Fluidounce, = 29.573 c. c.

MEASURES OF WEIGHT.

10 Milligrams, = 1 Centigram.
 10 Centigrams, = 1 Decigram.
 10 Decigrams, = 1 Gram.
 10 Grams, = 1 Decagram.
 10 Decagrams, = 1 Hectogram.

10 Hectograms, = 1 Kilogram.
 10 Kilograms, = 1 Myriogram.
 1 Gram, = 15.432349 grains. 1 Kilogram = 2½ lbs. (about).

Value of Apothecaries' or Troy Weights in Metric Weights.

These equivalents are only approximate, but are sufficiently accurate for practical purposes.

Grain.	Grams.	Grains.	Grams.	Apoth. Wt.	Grams.
1.64	0.00101	i	0.0648	ʒi	3.887
1.60	0.00107	ij	0.1295	ʒij	7.775
1.50	0.00129	ijj	0.1943	ʒiij	11.663
1.48	0.00134	iv	0.2591	ʒiv	15.550
1.40	0.00161	v	0.3239	ʒv	19.438
1.36	0.00179	vi	0.3887	ʒvi	23.325
1.32	0.00202	vij	0.4535	ʒvij	27.213
1.30	0.00215	viiij	0.5183	ʒviii	31.103
1.25	0.00259	ix	0.5831	ʒix	62.207
1.24	0.00269	x	0.6479	ʒx	98.311
1.20	0.00323	xij	0.7775	ʒxij	124.415
1.16	0.00404	xv	0.9718	ʒxv	155.519
1.15	0.00431	xvi	1.036	ʒxvi	186.623
1.12	0.00539	xviiij	1.166	ʒxviii	217.726
1.10	0.00647	xx	1.295	ʒxx	248.830
1.8	0.00809	xxiv	1.555	ʒxxiv	279.934
1.6	0.01079	xxv	1.619	ʒxxv	311.038
1.5	0.01295	xxx	1.943	ʒxxx	342.141
1.4	0.01619	xl	2.591	ʒxl	373.245
1.3	0.02159	l	3.239	ʒl	746.491
1.2	0.03239	lx	3.887	ʒlx	1119.726

To express quantities by weight of the Apothecaries' system in Metric terms.

(1) Reduce each quantity to grains; then divide the number by 10, and from the quotient subtract one-third. Or, (2) reduce each quantity to drachms, and multiply the number by 4. Or, (3) reduce each quantity to ounces, and multiply the number by 32. The product in each case will be the number of grams representing (nearly) the same quantity.

To express quantities by measure of the Apothecaries' system in Metric terms.

(1) Reduce each quantity to minims; then divide the number by 10, and from the quotient subtract one-third. Or, (2) reduce each quantity to fluidrachms, and multiply the number by 4. Or, (3) reduce each quantity to fluidounces, and multiply the number by 32. The product in each case will be the number of cubic centimeters representing (nearly) the same quantity.

PRESCRIPTION WRITING.—In writing prescriptions in the metric system, the abbreviation, "gm." may be used for gram, and "c. c." for cubic centimeter. It may also be well to underscore the abbreviations, thus "gm." and "c. c." in order to prevent mistakes in the case of careless writing.

